

# **Field Sampling Plan for Lysimeter, Tensiometer, and Vapor Port Monitoring at the RWMC Active Low-Level Waste Pit**

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November 2005

**Idaho  
Cleanup  
Project**

The Idaho Cleanup Project is operated for the  
U.S. Department of Energy by CH2M ♦ WG Idaho, LLC

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Idaho Falls, Idaho 83415**

**Prepared for the  
U.S. Department of Energy  
Assistant Secretary for Environmental Management  
Under DOE Idaho Operations Office  
Contract DE-AC07-05ID14516**

## **ABSTRACT**

Monitoring for contaminant movement in the Active Low-Level Waste Pit (LLWP) at the Radioactive Waste Management Complex (RWMC) within the Idaho National Laboratory Site is conducted as part of the Idaho Cleanup Project's monitoring program. This plan outlines the sampling objectives, locations, priorities, data evaluation, and process for monitoring in the Active LLWP at the RWMC. The objectives of lysimeter, tensiometer, and vapor port monitoring are to determine if contaminants have migrated from the waste zone of the Active LLWP at the RWMC to surrounding soils, and collect data on the spatial extent of contamination. Data obtained from lysimeters, vapor ports, and tensiometers will be used to support several purposes and programs including the Performance Assessment and Composite Analysis Monitoring Program, fate and transport modeling, Idaho National Laboratory oversight groups, and subsurface sciences at the RWMC.



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## ACRONYMS

AA	alternative action
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CSA	CERCLA Storage Area
DOE	U.S. Department of Energy
DOT	Department of Transportation
DQO	data quality objective
EDF	engineering design file
EPA	U.S. Environmental Protection Agency
FSP	field sampling plan
FTL	field team leader
HEPA	high-efficiency particulate air
INL	Idaho National Laboratory
IWTS	Integrated Waste Tracking System
LLW	low-level waste
LLWP	Low-Level Waste Pit
MCP	management control procedure
OU	operable unit
PA/CA	Performance Assessment and Composite Analysis Monitoring Program
PPE	personal protective equipment
PSQ	principal study question
QAPjP	quality assurance project plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RWMC	Radioactive Waste Management Complex

SAM	Sampling and Analysis Management
SAP	sampling and analysis plan
SDA	Subsurface Disposal Area
TPR	technical procedure
TRU	transuranic
TSA	Transuranic Storage Area

# Field Sampling Plan for Lysimeter, Tensiometer, and Vapor Port Monitoring at the RWMC Active Low-Level Waste Pit

## 1. INTRODUCTION

### 1.1 Scope

This field sampling plan (FSP) supports the Performance Assessment and Composite Analysis Monitoring Program (PA/CA) for the Active Low-Level Waste Pit (LLWP) at the Radioactive Waste Management Complex (RWMC). The role of lysimeter, tensiometer, and vapor port monitoring under the buried waste is to monitor and characterize contaminant migration in the soil moisture and in the unsaturated zone of the Active LLWP within the RWMC to support efforts to protect the quality of the Snake River Plain Aquifer.

Together, this FSP and the *Quality Assurance Project Plan for Waste Area Groups 1, 2, 3, 4, 5, 6, 7, 10, and Deactivation, Decontamination, and Decommissioning* (DOE-ID 2004) are considered the sampling and analysis plan for the project. This FSP has been prepared in accordance with the Idaho Cleanup Project management control procedure (MCP), “Environmental Sampling Activities at the INEEL” (ICP-MCP-9439) and describes the field activities that are part of the investigation. The *Quality Assurance Project Plan (QAPjP)* (DOE-ID 2004) describes the processes and programs that ensure the generated data will be suitable for the intended use.

The Idaho Cleanup Project will routinely collect lysimeter and vapor port samples, and tensiometer data from the Active LLWP to monitor for evidence of contaminant migration from the Active LLWP and provide data that will aid in characterizing the spatial extent of contamination for the PA/CA, if contamination is present. The data collected will aid in the understanding of the fate and transport of contaminant migration from the Active LLWP in the Subsurface Disposal Area (SDA), help fill previously identified data gaps, and support the selection of appropriate remedial alternatives.

### 1.2 Idaho National Laboratory Site Background

The Idaho National Laboratory (INL) Site is a U.S. Department of Energy (DOE) facility, located 52 km (32 mi) west of Idaho Falls, Idaho, that occupies 2,305 km<sup>2</sup> (890 mi<sup>2</sup>) of the northeastern portion of the Eastern Snake River Plain. The RWMC is located in the southwestern portion of INL Site, as shown in Figure 1. The SDA is a 39-hectare (97-acre) area located within the RWMC (see Figure 2). The SDA consists of 20 pits (including the Active LLWP), 58 trenches, 21 soil vault rows, Pad A, and the Acid Pit where waste disposal activities occurred.

The *Federal Facility Agreement and Consent Order* (DOE-ID 1991) establishes the procedural framework and schedule for developing, prioritizing, implementing, and monitoring response actions at the INL Site in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC § 9601 et seq. 1980); the Resource Conservation and Recovery Act (RCRA) (42 USC § 6901 et seq. 1976); and the Idaho Hazardous Waste Management Act (Idaho Code § 39-4401 et seq. 1983). The U.S. Environmental Protection Agency (EPA) proposed listing the INL Site on the National Priorities List of the National Contingency Plan on July 14, 1989 (54 FR 29820). This was done using hazard ranking system procedures found in the National Contingency Plan. The hazard ranking system is a model that evaluates relative potential of uncontrolled

hazardous substances to cause human health/safety or ecological/environmental damage. This system scores the relative potential on a scale of 0 to 100. Sites scoring 28.50 or higher are eligible for the National Priorities List. The score for the INL Site was 51.91. After considering public input during a 60-day comment period following the proposed INL listing, the EPA issued a final rule listing the INL Site. The rule was published in the Federal Register on November 21, 1989 (54 FR 48184).

Comprehensive INL Site historical and geological information relevant to the RWMC is provided in the *Ancillary Basis for Risk Analysis of the Subsurface Disposal Area* (Holdren et al. 2002).

### 1.3 Radioactive Waste Management Complex History

The Atomic Energy Commission selected the RWMC, located in the southwestern corner of the INL Site (Figure 1), as a waste disposal site for solid low-level radioactive waste (LLW) in 1952.

The RWMC encompasses a total of 72 hectares (177 acres) and is divided into three areas by function: the SDA as shown in Figure 3, the Transuranic Storage Area (TSA), and the administration and operations area. The Active LLWP is located in the SDA.

#### 1.3.1 Subsurface Disposal Area

The SDA comprises all property from the center of the RWMC westward and is surrounded by a soil berm and drainage channel. The RWMC was initially established in July 1952 as the National Reactor Testing Station Burial Ground on 5 hectares (13 acres). The facility was expanded incrementally over the years to cover 39 hectares (97 acres). Radioactive and hazardous waste has been disposed of in the SDA, and there is an active disposal area within the SDA, which still receives LLW.

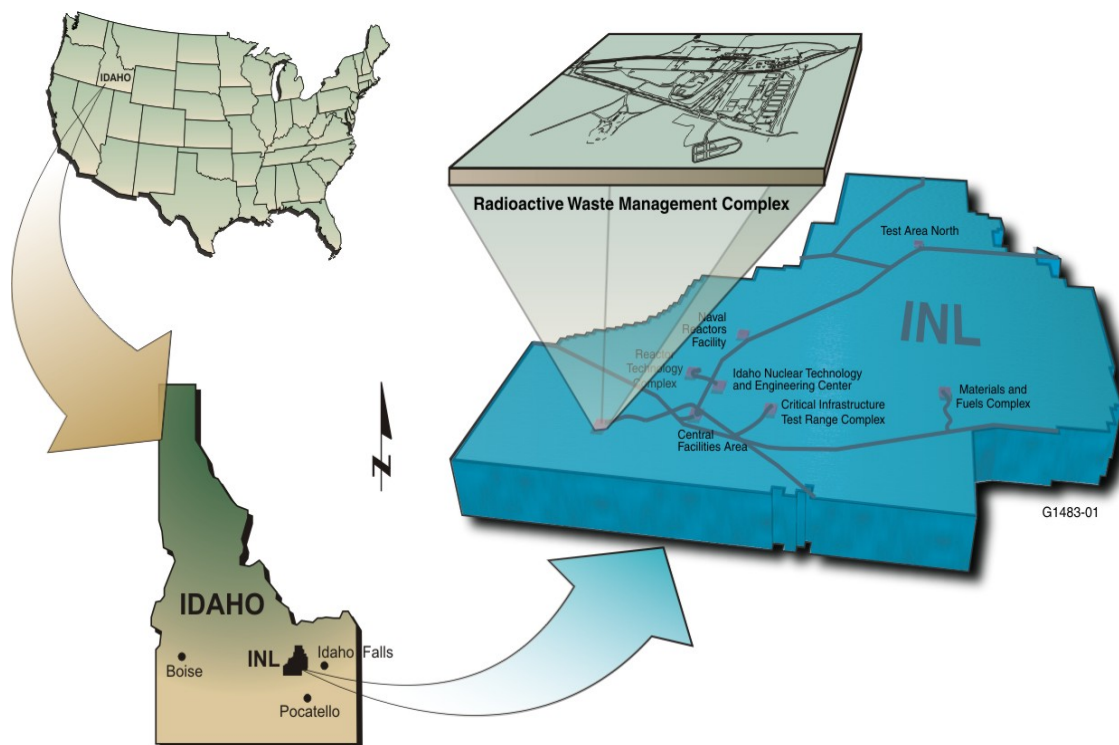


Figure 1. Map showing the location of the Radioactive Waste Management Complex at the Idaho National Laboratory Site.

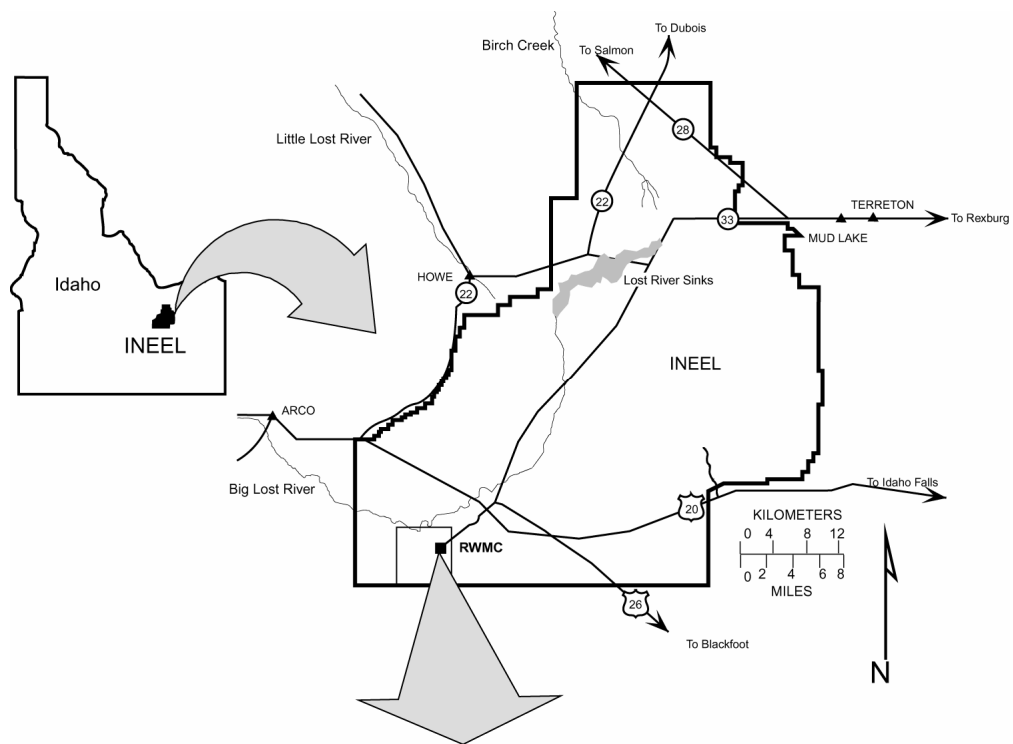


Figure 2. RWMC and its location (photo is rotated with north to the left).

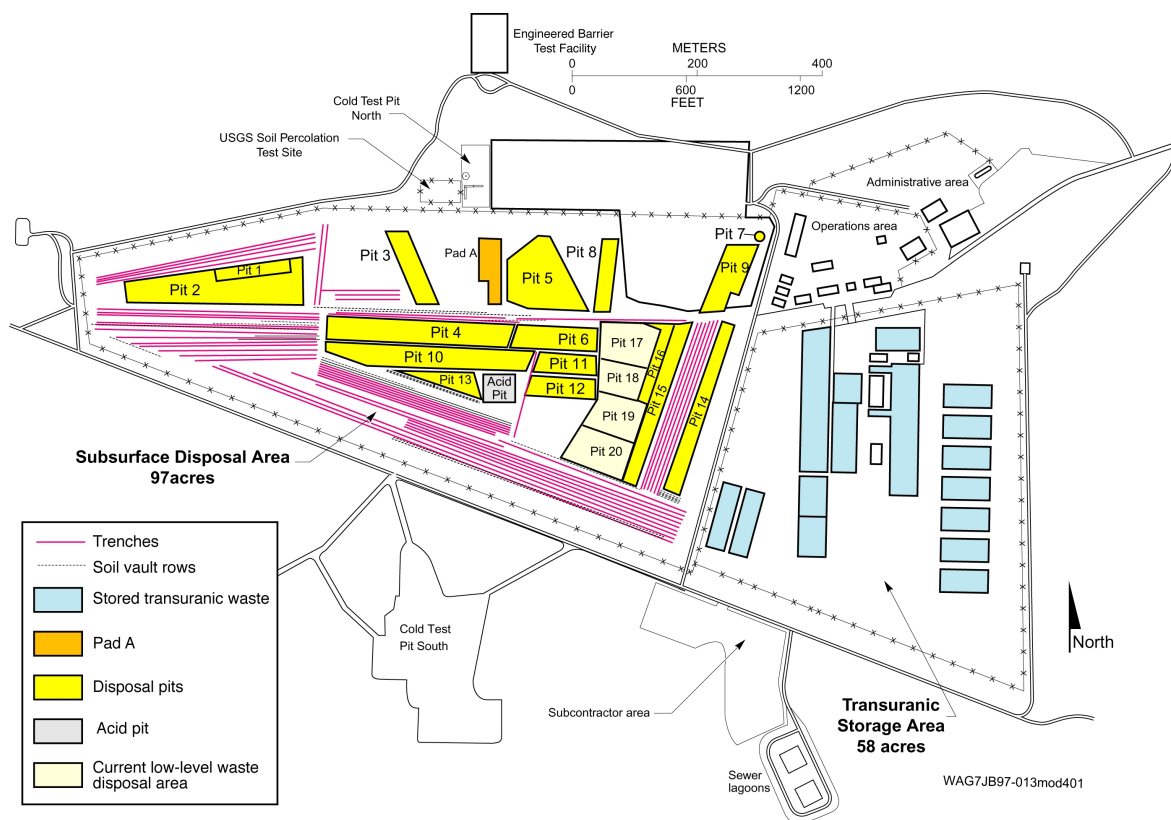


Figure 3. Subsurface Disposal Area at the Radioactive Waste Management Complex.

Both transuranic (TRU) and LLW were buried in pits, trenches, soil vaults, and one aboveground pad (Pad A) since 1952. Through 1970, the SDA was a disposal site for TRU and mixed waste, most of which came from the Rocky Flats Plant in Colorado. Mixed waste that contained hazardous chemical and radioactive contaminants was accepted through 1984. Since 1985, waste disposal in the SDA has been limited to LLW from INL waste generators.

### 1.3.2 Transuranic Storage Area

The TSA is a 23.5-hectare (58-acre) facility located on the east side of the SDA (see Figure 3). The TSA was established in 1970 as an interim storage facility when subsurface disposal of waste containing TRU concentrations greater than 100 nCi/g in the SDA was discontinued. Operations at the TSA include waste segregation, examination, and certification in addition to interim storage.

### 1.3.3 Administration and Operations Area

The 9-hectare (22-acre) administration and operations area contains administrative offices, security and gatehouse operations, radiological control support, maintenance buildings, equipment storage, and miscellaneous support facilities (see Figure 3). A more detailed summary of RWMC operations is provided in the *Ancillary Basis for Risk Analysis of the Subsurface Disposal Area* (Holdren et al. 2002).

The current mission of the Idaho Cleanup Project is to provide waste management for the present and future needs of the INL and for assigned DOE off-Site generators of LLW and TRU waste.



### 1.3.4 Low-Level Waste Pit Area

The Active LLWP (Figure 4) is located on the east end of the SDA. About 5,000 m<sup>3</sup> of low-level radioactive waste are disposed of at the Active LLWP in the SDA each year. Under the *Performance Management Plan* (DOE-ID 2002), the goal is to continue disposal of contact-handled LLW through 2008 and to continue disposal of remote-handled LLW through 2009.

Numerous measures are currently in place to limit the potential for occupational or public exposures to waste disposed of in the SDA. An air-monitoring network is in place to monitor airborne releases. Location-specific air and soil gas monitoring are also conducted in specific areas at the SDA. An extensive surface water management system, including dikes and drainage channels, has been implemented at the SDA to minimize the potential for flooding and releases by way of surface water. Other controls include detailed procedures and safety reviews for all work to be conducted in the SDA, and the Active LLWP, security fences and access controls, and land-use controls that restrict public access to the INL Site.



Figure 4. Photo of currently operating LLW disposal pits within the SDA.

## 1.4 Nature and Extent of Potential Contamination in the Active LLWP

Historically, most of the LLW arrived at the RWMC packed in containers such as large wooden boxes with plastic liners. Currently, metal boxes, soft-sided bags, drums, and bulk waste are received at the Active LLWP. The Active LLWP is a continuous excavation consisting of SDA pits 17 through 20. The pits have been excavated through the surficial sediments to the basalt which is typically at a depth of 9.1 m (30 ft). Before placement of waste, the floor of the pit is backfilled with 0.7 m (2 ft) of sediment and a 0.3-m (1-ft)-thick layer of gravel. Geotextile fabric is placed between the sediment and gravel in some locations to add stability to the waste stack and to provide a more stable surface for waste moving equipment. The pits were opened in May 1984 with the original dimensions of approximately 200 m (658 ft) long, 30 m (100 ft) wide, and 9.1 m (30 ft) deep. Pits 17 and 18 have been filled, and waste is now being placed in pits 19 and 20.

## **2. DESCRIPTION OF MONITORING INSTRUMENTS**

The following three types of instruments are being monitored as part of this investigation:

- Lysimeters
- Tensiometers
- Vapor ports.

### **2.1 Lysimeters**

Lysimeters are designed to collect soil liquid samples under either saturated or unsaturated conditions. To collect the liquid sample, a partial vacuum is applied on the porous section of the lysimeter (porous stainless steel with a 0.2- $\mu$  pore size) that is in contact with the soil, and soil moisture is drawn into the lysimeter body. The sample liquid is removed from the lysimeter by applying positive pressure to the lysimeter, which pushes the collected liquid up a tube to the surface and into a sample container. The amount of liquid collected and duration of collection depends on the (1) available soil moisture, (2) soil water potential, (3) conductivity of the porous material in the lysimeter, and (3) vacuum applied. The sample volume is also limited to 1 L, the volume of the collection reservoir.

### **2.2 Tensiometers**

Tensiometers are used to measure the matric potential<sup>a</sup> of a porous medium under unsaturated conditions or the pressure head if saturated conditions form. Matric potential is used to (1) calculate hydraulic gradients, (2) determine the direction of soil liquid movement in the vadose zone, and (3) calculate the rate of flow, given the hydraulic conductivity of the materials, determined from laboratory analysis of soil samples or assumed for the material in the waste zone. Very specific elements were incorporated into the design of these tensiometers to mitigate concerns with open radiological pathways that would have been a concern with standard tensiometers.

The following items are functions of these tensiometers or the monitoring networks they support:

- Indication of the moisture state and its variability, spatially and temporally, within the waste zone
- Quantification of the amount and timing of infiltration through the waste zone
- Determination of the amount and lateral extent of the development of perched water toward the bottom of the waste zone.

### **2.3 Vapor Ports**

Vapor ports have been installed to sample soil gas vapors from the Active LLWP in the SDA. These ports are constructed of 3/8-in. stainless steel tubing that has been perforated near the bottom of the tubing. The probe end has been installed in the 0.7-m-thick (2-ft-thick) soil that covers the bottom of the pit. The remaining tubing was bolted to the waste containers in the pit and soil was placed around the tubing as areas of the pit were covered. The sample tubes have been terminated at ground surface with quick connect fittings and valves so the ports can be sampled using the process described in technical procedure (TPR) -1674. Soil-gas samples will be collected above ground by applying a vacuum to the vapor port line. 1-L Tedlar® bags will be used to collect the vapor samples for laboratory analysis.

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a. The field (potential) describing the forces acting on soil water, independent of chemical and gravitational potential, that causes water to move through the soil.



### **3. SAMPLING OBJECTIVES, ANALYTE LIST, LOCATION, AND FREQUENCY**

#### **3.1 Sampling Objectives**

Present plans indicate that disposal operations will continue until 2008 for contact-handled LLW and until 2009 for remote-handled LLW waste (DOE-ID 2002); however, the new ICP contract does not preclude changes being made to the end-time of disposal operations. The data collected will aid in the understanding of fate and transport of contaminant migration from the Active LLWP, help fill previously identified data gaps, and support the PA/CA. Secondary objectives include improved understanding of water movement through the vadose zone. The primary uses of the data gathered during tensiometer monitoring and lysimeter and vapor port sampling are to identify contaminants, determine concentration trends, and record their movement in the Active LLWP.

Samples collected from the vadose zone may have limited volume due to arid conditions at the INL Site. Because of the possible limited volumes, this project has established analytical priorities for the lysimeter samples. The priorities are periodically reviewed and updated based on emerging issues and needs. Priorities were established by weighing (1) the contaminant's risk, (2) the inventoried quantity of disposed material, (3) the analytical detectability, (4) the detection frequency, and (5) the value to the PA/CA. The analytical priorities for this project are listed in Table 1.

Data quality objectives (DQOs) are discussed in the context of the DQO process as defined by *Guidance for the Data Quality Objectives Process* (EPA 2000). This process was developed by EPA to ensure that the type, quantity, and quality of data used in decision-making are appropriate for the intended application. The DQO process includes seven steps, each of which has specific outputs. The DQO process has been, and will continue to be, used for each of the sampling activities conducted for the Active Low-Level Waste Pit. Each of the following subsections corresponds to a step in the DQO process, and the output for each step is provided as appropriate. Because sample collection will occur at various times during the closure activity, and the data use for each sample collection activity may vary, the outputs for each DQO step will reflect these data needs and uses.

##### **3.1.1 Problem Statement**

The first step in the DQO process is to clearly state the problem to be addressed in the sampling activity. The intent of this step is to clearly define the problem so that the focus of the activities will be unambiguous. The appropriate outputs for this step are (1) a concise description of the problem, (2) a list of the planning team members, (3) identification of the decision-maker(s), and (4) a summary of available resources and relevant deadlines for the study.

The planning team members, decision-makers, and schedule are all part of the Waste Generator Services Life Cycle Baseline planning document. The problem statement is that there is a need to identify any contaminant movement in the Active Low-Level Waste Pit.

##### **3.1.2 Decision Statement**

The second step in the DQO process is to identify the decisions and the potential actions that will be affected by the data collected. This is done by specifying principal study questions (PSQs) and alternative actions (AAs) that could result from resolution of the PSQs, and by combining the PSQs and AAs into decision statements.

The objective of sampling within the Active LLWP is to answer the following PSQ:

- Are any contaminants of concern being released from the containerized waste into the surrounding interstitial soils, and at what rate?

The AAs to be taken depending on the resolution of the PSQ are as follows:

- The actions that will be taken are dependent on the levels of contamination, the types of constituents, and the rate at which they are being released. The Project Manager, along with the data analysts will monitor the data, and present the data in an annual report, along with any actions which may be required.

### **3.1.3 Decision Inputs**

The third step in the DQO process is to identify the informational inputs required to resolve the decision statement and to determine which inputs require measurement. To resolve the decision statement in Section 3.1.2, the information input needed is the identification and quantification of contaminants of concern in the lysimeter and vapor samples. Then, to resolve the decision statement, concentrations and types of constituents present in the interstitial soils must be determined.

### **3.1.4 Study Boundaries**

The fourth step in the DQO process is to define the spatial and temporal boundaries of the study. The spatial boundaries define the physical extent of the study area; they may be subdivided into specific areas of interest. The temporal boundaries define the duration of the entire study or specific parts of the study. The appropriate outputs of this step are a detailed description of the spatial and temporal boundaries of the problem and a discussion of any practical constraints that may interfere with the study.

The Active Low Level Waste Pit is defined in section 1.3.4 of this document. There are 4 pits which make up the Active Low-Level Waste Pit. Currently, 2 of these pits; Pit 17, and pit 18 are filled, and contain a cover. Only those sample ports identified in section 3.2.1 will be sampled as part of this project.

### **3.1.5 Decision Rule**

The fifth step in the DQO process is to (1) define the parameters of interest that characterize the population, (2) specify the action level, and (3) integrate previous DQO outputs into a single statement that defines the conditions that would cause the decision-maker to choose among AAs. The decision rule typically takes the form of one or more “If...then” statements describing the action or actions to take if one or more conditions are met.

All decisions and action levels will be evaluated and integrated as part of the annual Performance Assessment and Composite Analysis Monitoring Program (PA/CA) for the Active LLWP.

### **3.1.6 Decision Error Limits**

The sixth step in the DQO process is to minimize uncertainty in the data by specifying tolerable limits on decision errors. The limits are used to establish performance goals for the data collection design. The possible range for the parameter of interest is determined, and the types of decision errors and the potential consequences of the errors are defined.

In order to minimize uncertainty in the data for this project, quality assurance objectives for measurement will meet or surpass the minimum requirements for data quality indicators established in the QAPjP (DOE-ID 2004). Parameters which will be in place to minimize uncertainty are presented in Section 3.3, and include; precision, accuracy, representativeness and completeness.

### 3.1.7 Design Optimization

The last step in the DQO process is design optimization. The purpose of design optimization is to identify the best sampling and analysis design that satisfies all of the previous steps in the process.

After completion of these activities, this project team has provided operational details and theoretical assumptions of the selected design, which are detailed and documented in this FSP.

## 3.2 Analyte List

The analyte list is determined by the project manager. If there is no previous sampling history in the Active LLWP, the analyses will be based on analytes detected in the SDA areas surrounding the Active LLWP.

Table 1. Sample analyte list in order of priority.

Analyte Priority	Preservative	Contract Required Detection Limits (pCi/L or mg/L)	Sample Volume (ml)	Justification
Gamma Spectroscopy	HNO <sub>3</sub> to pH<2	<200	50	Gamma spectroscopy is a nondestructive analysis that provides data on several contaminants of concern.
C-14	None	<50	50 (Vapor Sample)	High-risk driver, highly mobile ( $K_d \sim 5$ mL/g). Detected in vadose zone (perched water and soil moisture samples).
H-3	None	<250	50 (Vapor Sample)	Low-risk driver. Detected in vadose zone (perched water and soil moisture samples) at isolated locations.
Tc-99	HNO <sub>3</sub> to pH<2	<15	50	Tc-99 is a contaminant of concern, high-risk driver and highly mobile ( $K_d \sim 0$ mL/g). Tc-99 is detected in the vadose zone (core, soil moisture, and perched water samples).
Uranium Isotopes	HNO <sub>3</sub> to pH<2	<2 for each	50	Contaminants of concern, risk drivers. Uranium consistently detected above risk-based concentrations and EPA maximum contaminant levels at various locations.
I-129	None	<40	50	High-risk driver, highly mobile ( $K_d \sim 0.1$ ). Intermittently detected in vadose zone (soil moisture) at levels > maximum contaminant levels.

Table 1. (continued).

Analyte Priority	Preservative	Contract Required Detection Limits (pCi/L or mg/L)	Sample Volume (ml)	Justification
Cl-36	HNO <sub>3</sub> to pH<2	100	50	Not well characterized in the vadose zone; associated with beryllium blocks; seldom detected.
Plutonium 239/240	HNO <sub>3</sub> to pH<2	<2 for each	50	Contaminant of special consideration.
Np-237	HNO <sub>3</sub> to pH<2	<2	50	High-risk driver, highly mobile ( $K_d \sim 8$ ). Not detected in vadose zone but detected in waste zone.
Gross Alpha/Beta	HNO <sub>3</sub> to pH<2	10/5	50	Alpha/Beta spectroscopy is a nondestructive analysis that provides data on several contaminants of concern.
Ni-59	HNO <sub>3</sub> to pH<2	50	50	Contaminant of special consideration.
Th-232	HNO <sub>3</sub> to pH<2	<2	50	Contaminant of special consideration.
Sr-90	HNO <sub>3</sub> to pH<2	<6	50	Contaminant of special consideration.
Ra-226	HNO <sub>3</sub> to pH<2	10	50	Contaminant of special consideration.

### 3.2.1 Sampling Location

Figure 5 shows the location of monitoring instruments within the LLWP. Table 2 identifies the Active LLWP wells which have monitoring instruments installed.

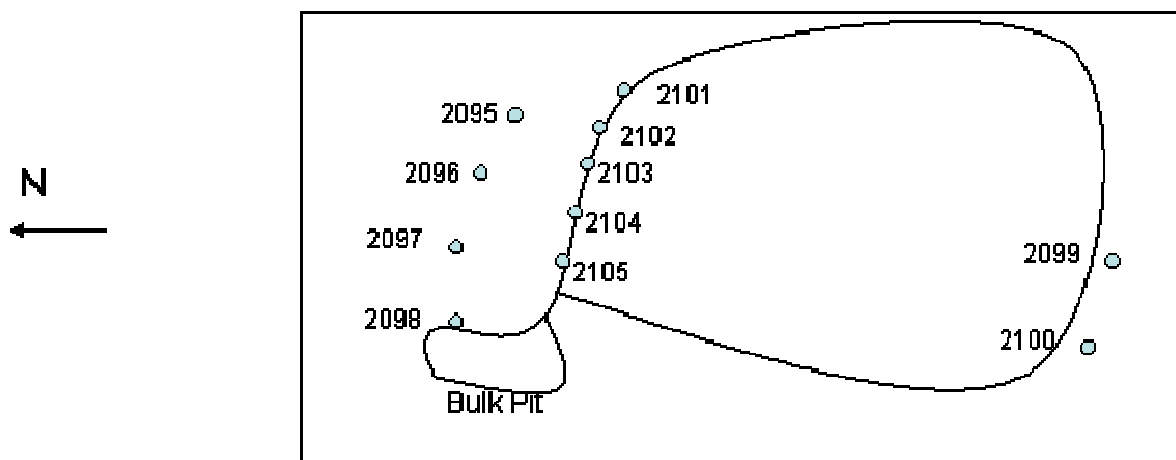


Figure 5. Location of the monitoring instruments within the active LLWP.

Table 2. Active LLWP wells which have monitoring instruments.

Well Name	Lysimeter	Vapor Port	Surf. Elev.
2095	DL71	2095-VP1	5013.45
2096	DL72	2096-VP1	5012.86
2097	DL73	2097-VP1	5011.15
2098	DL74		5013.99
2099	DL75	2099-VP1 2099-VP2	5009.09
2100	DL76	2100-VP1 2100-VP2	5008.69
1208	DL82		5012.58

### 3.2.2 Sampling Frequency

Table 3 identifies the frequency of the sampling for the three types of instruments in the Active LLWP.

Table 3. Sampling frequency.

Instrument Type	Frequency	Sample Matrix
Lysimeter	Semi-Annually	Liquid
Vapor Ports	Semi-Annually	Vapor
Tensiometers	Continual	Matric Potential

## 3.3 Quality Assurance Objectives for Measurement

The quality assurance objectives for measurement will meet or surpass the minimum requirements for data quality indicators established in the QAPjP (DOE-ID 2004). The QAPjP provides minimum requirements for the following measurement quality indicators: precision, accuracy, representativeness, completeness, and comparability. Precision, accuracy, and completeness will be calculated in accordance with the QAPjP.

### 3.3.1 Precision

Precision is a measure of the reproducibility of measurements under a given set of conditions. In the field, precision is affected by sample collection procedures and the unknown and potentially extreme heterogeneity of the buried waste. Overall precision (i.e., field and laboratory) evaluations can be supported by collecting duplicate samples.

Laboratory precision will be based on the use of laboratory-generated duplicate samples or matrix spike and matrix spike duplicate samples. Evaluation of laboratory precision will be performed during the process of method data validation.

Field precision will be based upon the analysis of collected field duplicate or split samples. For samples collected for laboratory analyses, a field duplicate will be collected at a minimum frequency of 1 in 20 environmental samples or 1 per day per matrix, whichever is less.

### **3.3.2 Accuracy**

Accuracy is a measure of bias in a measurement system. Bias is the systematic or persistent distortion of a measurement process that causes errors in one direction. Laboratory accuracy is demonstrated using laboratory control samples, blind quality control (QC) samples, and matrix spikes. Evaluation of laboratory accuracy will be performed during the method data validation process. Sample preservation and handling, field contamination, and the sample size and matrix affect overall accuracy. Results of field blanks, trip blanks, and equipment rinsates will be reviewed to assess the reliability of suspect false positives or high-biased sample results. The representativeness of the sample (discussed below) is also a factor in the overall accuracy of the result.

Field accuracy will only be determined for samples collected for laboratory analysis. The field screening instrumentation can only analyze the soils and is not set up for the analysis of water samples. Therefore, accuracy of field instrumentation will be ensured through the use of appropriate calibration procedures and standards.

### **3.3.3 Representativeness**

Representativeness is a qualitative parameter that expresses the degree to which the sampling and analysis data accurately and precisely represent a characteristic of a population, the parameter variations at a sampling point, or an environmental condition. Representativeness will be evaluated by determining whether measurements are made and physical samples are collected so that the resulting data appropriately measure the media and phenomenon studied. The comparison of all field and laboratory analytical data sets obtained throughout this remedial action will ensure representativeness.

### **3.3.4 Detection Limits**

Detection limits will meet or exceed the risk-based or decision-based concentrations for the contaminants of concern. Detection limits will be as specified in the Sample and Analysis Management (SAM) Analytical Services Statement of Work (ER-SOW-394), project-specific Task Order Statements of Work, and as described in the QAPjP (DOE-ID 2004).

### **3.3.5 Completeness**

Completeness is a measure of the quantity of usable data collected during the field sampling activities. The QAPjP (DOE-ID 2004) requires that an overall completeness goal of 90% be achieved for noncritical samples. If critical parameters or samples are identified, a 100% completeness goal is specified. Critical data points are those sample locations or parameters for which valid data must be obtained in order for the sampling event to be considered complete. Given that this is a monitoring project, all field screening and laboratory data will be considered noncritical with a completeness goal of 90%.

### **3.3.6 Comparability**

Comparability is a qualitative characteristic that refers to the confidence with which one data set can be compared to another. At a minimum, comparable data must be obtained using unbiased sampling designs. If sampling designs are not unbiased, the reasons for selecting another design should be well

documented. Data comparability will be assessed through the comparison of all data sets collected during this study for the following parameters:

- Data sets will contain the same variables of interest
- Units will be expressed in common metrics
- Similar analytical procedures and quality assurance will be used to collect data
- Time of measurements of variables will be similar
- Measuring devices will have similar detection limits
- Samples within data sets will be selected in a similar manner
- The number of observations will be of the same order of magnitude.

### **3.3.7 Data Validation**

Method data validation is the process whereby analytical data are reviewed against set criteria to ensure that the results conform to the requirements of the analytical method and any other specified requirements.

All laboratory-generated analytical data will be validated to Level “B” as described in Guide (GDE) -7003, “Levels of Analytical Method Data Validation.” Field-generated data will not be validated. Quality of the field-generated data will be ensured through adherence to established operating procedures and use of equipment calibration, as appropriate.

## 4. SAMPLE IDENTIFICATION

### 4.1 Sample Designation

A systematic 10-character sample identification code will be used to uniquely identify all samples. The uniqueness of the number is required to maintain consistency and ensure that no two samples are assigned the same identification code. The sample numbers are assigned by SAM personnel. Unique sample numbers will be generated in the SAM database for each sampling event. The unique sample number will be broken down into the following five parts (Table 4).

Table 4. Sample number format.

Sample Number Part	Definition
Initial project identifier	LL – low-level waste pit
Basic sample origin (either lysimeter or vapor port)	L – lysimeter-based water samples; V – gas samples originating from vapor ports
Sequential sampling event number	001 through 999 – a number unique to the individual sampling event (i.e., the group of samples collected from a single sampling port [e.g., deep lysimeter]) during the same time period
Field quality control identifier	01 – regular sample; 02 – field duplicate sample
Analysis code	XX – the final two characters refer to the analysis code identified in the sample plan tables

### 4.2 Sampling and Analysis Plan Table Fields

A Sampling and Analysis Plan (SAP) table format was developed to simplify the presentation of the sampling scheme for project personnel. The following describe the information recorded in the SAP table and database.

#### 4.2.1 Sampling Activity

The sampling activity field contains the first six characters of the assigned sample number. The sample number in its entirety will be used to link information from other sources (e.g., field data, analytical data) to the information in the SAP table for data reporting, sample tracking, and completeness reporting. The analytical laboratory will also use the sample number to track and report analytical results.

#### 4.2.2 Sample Type

Data in this field will be selected from the following:

- REG for a regular sample
- QC for a quality control field sample.

#### 4.2.3 Sample Matrix

This field describes the sample media/matrix, typically liquid for certain QC samples.



#### **4.2.4 Collection Type**

This field is typically populated with GRAB or other codes for certain types of QC samples (e.g., FBLK for field blank).

#### **4.2.5 Planned Date**

This date is related to the approximate sample collection start date.

#### **4.2.6 Area**

This field identifies the general sample collection area, which is RWMC.

#### **4.2.7 Location**

This field contains the name of the well (well repository ID) and lysimeter or vapor port from which the sample was taken (e.g., 2099).

#### **4.2.8 Type of Location**

This field supplies descriptive information concerning the type of sample location, typically LYSIMETER (for lysimeters) or VAPOR (for vapor port)

#### **4.2.9 Depth**

The depth field contains the depth at which the respective sample was collected.

#### **4.2.10 AT1–AT20**

These fields contain analysis code designations. Specific descriptions for these analysis codes are provided at the bottom of the SAP table.

## **5. SAMPLING EQUIPMENT AND PROCEDURES**

Field sampling methods and field analyses that may be performed are discussed in detail in TPR-1641, “Collection of Vadose Zone Water Samples at the RWMC,” and TPR-1674, “Sample Acquisition from Probes in the Subsurface Disposal Area.”

### **5.1 Sample Collection**

#### **5.1.1 Site Preparation**

Various engineering design files (EDFs) and TPRs describe the design of the systems and detail operations that support successful sample acquisition during this project. Before sampling, all sampling personnel are responsible for reading the FSP, the corresponding health and safety plan, and TPR-1674 (with glove bag) or TPR-1641 (without glove bag). All sampling personnel need to be familiar with the analytical requirements for that sampling round as stated in the SAP table. The field team leader (FTL) will perform a prejob briefing to discuss potential hazards and ensure that all personnel have the required training. The FTL or assigned team member will maintain all documents and field data. This should be noted in the appropriate logbook.

All required documentation and safety equipment will be assembled in the area where sampling will occur, including glove bag with high-efficiency particulate air (HEPA) filter, adequate sample collection containers (bottles for lysimeter sampling or Tedlar® bags for vapor port sampling), an Argon gas bottle and regulator; power source (generator); and a vacuum pump and gauge. All samples that require glove bag collection in the field are acquired with equipment defined in EDF-ER-239, “OU 7-13/14 Integrated Probing Project Sample Acquisition and Glove Bag Design.” This EDF describes the design of the sample acquisition equipment from the manifold located at the probe outlet ports to the delivery of a (preserved) sample. This EDF includes the design of the glove bags and auxiliary equipment to support sample acquisition. TPR-1674 is used to collect these samples. This TPR includes all aspects of acquiring samples from lysimeters and vapor ports in glove bags in the field. The procedure includes water sample handling activities in the sample preparation facility. TPR-1641 will describe the steps necessary to collect liquid samples from these lysimeters if and when the glovebag is no longer required. This recommendation will be made by radiological engineering based upon a history of samples that exhibit low risk.

A sample preparation facility, expected to be located in building WMF-601, may be used to support sample preparation. The sample preparation facility contains a radiologically controlled hood to support sample preparation (e.g., splitting water samples from the sample collection vessel to sample containers) and an acid cabinet to store acids for sample preservation.

#### **5.1.2 Applying Vacuum to Lysimeters**

Sampling personnel will follow the guidance for applying the vacuum to the lysimeters as outlined in TPR-1674. The vacuum should be left on the lysimeter for 7 to 14 days. Sampling personnel should check the status of the vacuums periodically and apply additional vacuum as necessary. There is no preparation for Vapor Ports.

#### **5.1.3 Collecting Lysimeter Water Sample**

After the vacuum has been placed on the lysimeter for 7 to 14 days, sampling personnel will collect any soil moisture that has accumulated in the lysimeter. The liquid in the lysimeter should be removed by pressurizing the system with Argon gas, steadily increasing the pressure of the Argon through the air line

until the pressure exceeds the weight of the liquid in the lysimeter. This will force the liquid to the surface where it will be collected into a sampling container.

## **5.2 Field Documentation and Custody Requirements**

### **5.2.1 Field Documentation**

Additional details of the elements of sample documentation covered in this section are in the QAPjP. The field team leader or designee is responsible for controlling and maintaining all field documents and records and ensuring that all required documents are submitted to the Environmental Restoration field data coordinator within a reasonable time period. Necessary field documents include the following:

- Chain-of-custody forms
- Sample logbook
- This FSP
- Relevant TPRs.

### **5.2.2 Labels**

A waterproof, gummed label will be used to identify all samples. The labels will contain sample collection time and date, sample identification number, preservative used (if any), type of analysis, and other pertinent information. MCP-1192, “Chain of Custody and Sample Labeling for ER and D&D&D Projects,” establishes the sample container labeling procedure for this project.

### **5.2.3 Sample Custody**

The chain-of-custody record is a form that serves as a written record of sample handling. When a sample changes custody, the person(s) relinquishing and receiving the sample will sign a chain-of-custody record. Each change of possession will be documented, thus a written record that tracks sample handling will be established. MCP-1192 establishes the custody procedure for this project. Currently, there is an electronic chain of custody that can be used.

### **5.2.4 Logbooks**

Information pertaining to sampling activities will be entered in the sample logbook. Entries will be dated and signed by the individual making the entry. All logbooks will have a quality control check for accuracy and completeness. MCP-1194, “Logbook Practices for ER and D&D&D Projects,” establishes the logbook use and administration procedure for this project.

## **5.3 Analytical Requirements**

Due to the nature of collecting samples using a lysimeter, sample volumes are often very limited. Therefore, only laboratory control spikes, laboratory control spike duplicates, and laboratory control blanks will be used for laboratory QC. Field blanks are taken at the sample site.

Because inadequate volumes for all lysimeter sample analyses may be received, the order of analyses should be followed. The priority list for samples can be found in Table 1.

The radiation detection limits normally associated with the line item codes may not be achievable; the laboratory should strive to obtain radiation detection limits as low as reasonably achievable.

Soil-gas samples (vapor samples) will be collected above ground through vapor ports. The 1-L samples will be analyzed in the laboratory. Duplicate vapor port samples will be taken for quality purposes.

## **5.4 Waste Management**

Small amounts of investigation-derived waste may be generated by the sample-handling activities that support this project. The waste resulting from the activities during this sampling event could be classified into the following categories: (1) industrial (both conditional and nonconditional), (2) low-level, and (3) mixed low-level. These waste categories will be managed and disposed of under the direction of Waste Generator Services in accordance with MCP-3480, “Environmental Instructions for Facilities, Processes, Materials, and Equipment,” MCP-3475, “Temporary Storage of CERCLA-Generated Waste at the INEEL,” and applicable state and federal regulations. If unaltered samples are returned from the analytical laboratory or are archived for any reason, the samples will be handled in accordance with MCP-3480 as well.

All generated waste will be characterized as required by companywide management control procedures, DOE Orders 435.1, “Radioactive Waste Management,” and 5400.5, “Radiation Protection of the Public and the Environment,” and RCRA regulations found in 40 CFR 262.11. Based on the characterization, hazardous waste determinations will be performed and documented to assign the appropriate U.S. Environmental Protection Agency waste codes. A hazardous waste determination uses one of two approaches (or a combination of both) to determine whether the waste is RCRA hazardous waste. Process knowledge may be used if there is sufficient information to characterize the waste. Process knowledge may include direct knowledge of the source of the contamination or existing analytical data. Representative samples of the waste stream may also be analyzed. Process knowledge may influence the amount of sampling and analysis required to perform this characterization.

### **5.4.1 Waste Minimization and Segregation**

Project waste will be minimized through design and planning to ensure efficient operations that do not generate unnecessary waste. Waste reduction philosophies and techniques will be emphasized as part of the prejob briefing, and personnel will be encouraged to continuously attempt to improve methods for minimizing waste generation. Practices to be instituted to support waste minimization include, but are not limited to, the following:

- Restricting material, especially hazardous material entering radiological buffer areas, to that needed for work
- Substituting recyclable items for disposable items
- Reusing items, when practical
- Segregating contaminated and uncontaminated waste
- Segregating reusable items (e.g., personal protective equipment [PPE] and tools).

### **5.4.2 Packaging**

All waste material packaging will comply with the INL Waste Acceptance Criteria (DOE-ID 2005), U.S. Department of Transportation (DOT) regulations (49 CFR 171, 173, 177, and 178),

and RCRA regulations found in 40 CFR 264, Subpart I. Storage containers used to store hazardous waste must be in good condition and compatible with the waste being stored. It is also important that containers selected for storage of all waste (e.g., hazardous, radioactive, or industrial) are compatible with final disposition plans for the waste. This will alleviate the need for repackaging the waste before shipment to a treatment or disposal facility. The following general container categories are anticipated for storage of various Active LLWP project investigation-derived waste and contaminated environmental media, if necessary:

- 55-gal (208-L) drums
- 20 × 8 × 8-ft (9 × 29 × 29-m), or similarly dimensioned, steel-reinforced cargo containers.

Both WGS and packaging and transportation personnel will be consulted to verify the specific types of containers to be used for any waste. Only new or like-new containers will be used (except for cargo containers). Radioactive material must be packaged to adequately protect the material from weather, and the outside packaging must be free of removable radioactive contamination. It is anticipated that most of the contained waste and environmental media generated during the sampling investigations will be stored outside and, therefore, will need to be protected from the elements. The exception to this is waste stored in cargo containers.

### **5.4.3 Labeling**

All waste containers will be labeled appropriately. Conditional waste will be labeled as such. All CERCLA investigation-derived waste will be labeled with a CERCLA waste label that includes an accumulation start date, waste description, applicable waste codes, and the generator's name. Each container will have a barcode label generated from the INL Integrated Waste Tracking System (IWTS) database. All container labels will be placed where they are clearly visible during storage and shipment. Drums will be labeled on top and on the side. If cargo containers are used, they will be labeled on two opposing sides. Radiation labels will be completed and placed on each container by a radiological control technician, as required by the INL Radiological Control Manual. During shipment, other information must be included on containers, such as applicable DOT labels, manifest number, gross weight, and complete name and address of shipper.

### **5.4.4 Storage, Inspections, and Record Keeping**

Most containers of CERCLA investigation-derived waste generated from this investigation will be stored in a CERCLA storage area (CSA) located inside the SDA (e.g., CSA No. RWMC-CC027-SDA-A). Waste entering the CSA must comply with this FSP. The CSA complies with all applicable state and federal requirements regarding storage of hazardous and radioactive waste, including having a RCRA contingency plan, emergency communication system and equipment, alarms, and aisle space. When containers are brought into the CSA, the storage area operator will inventory the containers. Information to be recorded will include the IWTS barcode assigned to the container, type of container, type of waste inside the container (including potential waste codes), and the volume of waste inside the container. When each container is logged in, an evaluation will ensure incompatible waste will be segregated. Only personnel with the appropriate and required training will be allowed to receive waste into the CSA.

The CSA will be inspected weekly for leaks, spills, appropriate aisle space for emergency response, appropriate emergency response equipment, appropriate mitigation of any spills or noncompliance, compatibility between waste and containers, segregation requirements, appropriate labels, appropriate signs posted for compliance with applicable radiological requirements, and other applicable requirements and good practices. The weekly inspection will be documented in accordance with the CSA waste

management plan. Only personnel with the appropriate and required training will be allowed to perform weekly inspections of the CSA.

All information generated from the storage and inspection of waste in the CSA is considered a quality record and must be kept on file indefinitely. Other quality records to be kept include material and container profiles contained in the INL IWTS electronic database. This database contains quality records of (1) sampling and analytical data for waste streams, (2) the hazardous waste determinations for each waste stream, (3) the types, quantities, and content description of containers associated with each waste stream, (4) records of all waste movement (e.g., shipment to an offsite or onsite approved disposal facility), (5) appropriate land disposal restriction notification and certification, and (6) documentation reflecting compliance with debris treatment performance standards.

#### **5.4.5 Transportation**

All CERCLA investigation-derived waste generated during the sampling investigations and moved outside of the RWMC will be transported to storage areas or approved offsite or onsite treatment and disposal facilities, in accordance with requirements identified in the INL Waste Acceptance Criteria (DOE-ID-2005), and applicable DOT and RCRA regulations. The WGS and packaging and transport personnel will be responsible for shipping all CERCLA investigation-derived waste. Personnel having the proper documentation may transport industrial waste to the INL landfill complex.

#### **5.4.6 Waste Treatment and Disposition**

Waste generated during this sampling investigation must be managed and disposed of in accordance with all applicable project documents and state and federal regulations. Disposal options for the various waste classifications are discussed below. Prior to waste disposal, the waste streams must comply with the waste acceptance criteria of the intended receiving facility and approval for disposal must be obtained.

In limited cases, some hazardous debris treatment may be conducted on site to support waste disposition and waste minimization goals. Material that would normally be considered for decontamination (e.g., a plastic glove bag) may be candidate material for debris treatment under 40 CFR 268.45 of RCRA. In the context of implementing this plan, these hazardous debris treatment activities would be limited to washing and spraying nonporous materials (e.g., plastics). Hazardous debris (as provided in 40 CFR 268.45[c]) that has been treated using one of the specified extraction or destruction technologies, and does not exhibit a characteristic of hazardous waste after treatment (as identified in Subpart C, Part 261), is not hazardous waste and need not be managed in a Subtitle-C facility. However, any residues resulting from the treatment of hazardous debris (e.g., rags) will be managed in accordance with the relevant requirements of 40 CFR 268.45(d). These activities will be coordinated with WGS and project environmental affairs personnel.

#### **5.4.7 Conditional and Nonconditional Industrial Waste**

Conditional industrial waste would include clean PPE, RCRA-empty containers, or other items determined to be nonhazardous and nonradioactive. Conditional waste has been through the hazardous waste determination process and is typically disposed of in the INL landfill complex. Nonconditional industrial waste usually includes administrative paper waste and lunch-type waste, and is disposed of in green cold-waste dumpsters located around the INL. Waste from these dumpsters is disposed of at the INL landfill complex.

### 5.4.8 Mixed Hazardous and Radioactive Waste (Mixed Waste)

Some waste potentially generated during sampling activities may be classified as mixed waste, pending hazardous waste determination. Types of waste that could be classified as mixed waste include PPE, contamination control supplies, unused sample material, analytical residue, contaminated equipment, and decontamination fluid. Generally, waste coming into direct contact with liquid sample material collected from lysimeters would be candidate material for this characterization.

### 5.4.9 Radioactive Waste

Some waste may be classified as radioactive only (see Table 5). Radioactive waste has been identified as sample containers that held mixed waste and are now RCRA-empty. Disposal options include the RWMC or the INL CERCLA Disposal Facility.

Table 5. Potential waste generation and waste management considerations.

Potential Waste Stream	Base Composition	Probable Volume	Expected Characterization	Notes
Glove bags and internal piping and equipment	Plastics, high-efficiency particulate air (HEPA) filters, metal tubing, valves, and connectors	< 2 m <sup>3</sup> /year	Low-level waste (LLW) or mixed waste	—
Personal protective equipment (PPE) and wipes	Tyvek®, latex, Kimwipes®	< 2 m <sup>3</sup> /year	LLW or mixed waste	—
Liquid sample collection jars, laboratory pipettes	Fluorinated high-density polyethylene, Teflon, Tefzel® tubing, metal and plastic valves, glassware	<2 m <sup>3</sup> /year	LLW or mixed waste	Use of empty container rule to exit (Resource Conservation and Recovery Act [RCRA])
Original supply and sample container boxes, administrative waste paper	Paper, cardboard	< 1 m <sup>3</sup> /year	Nonconditional industrial waste	Disposition in green cold-waste dumpsters for INL landfill complex disposal
Used but “clean” PPE, nonradioactive RCRA -empty containers (e.g., Tedlar® bags used in volatile organic compound sampling)	PPE, Tedlar® bags, glass and plastic bottles	< 1 m <sup>3</sup> /year	Conditional industrial waste	INL landfill complex disposal expected Tedlar® bags expected to be conditional following radiological swipe of the inside of the “wasted” bags Bags protected by HEPA, residual volatile organic compound purged following analysis
Tygon® tubing, potentially C-14-gas contaminated	Tygon® or plastic tubing, metal valves, fittings	< 0.1 m <sup>3</sup> /year (15 ft/day)	LLW or conditional industrial waste	Radiological control technician evaluation required.

If any of the projected mixed waste streams can be determined to be no longer hazardous, the classification could change to radioactive only. All waste classifications will be documented by completed hazardous waste determinations. As previously stated, disposal options for radioactive waste include the RWMC.

## **6. SAMPLE HANDLING, PACKAGING, AND SHIPPING**

After lysimeter samples are collected, the gloved sampling technician will wipe the bottles to remove any residual water and will place them in the custody of the designated sample custodian. The sample custodian/shipper is responsible for ensuring that labels are in place, lids are checked for tightness, Parafilm is placed around lids, and samples are bagged and properly packaged before shipment. Additional information is found in MCP-1193, "Handling and Shipping Samples for ER and D&D&D Projects."

Lysimeter samples have been collected periodically from RWMC wells since the late 1980s. The laboratory results from all of these samples show that the samples are well below the U.S. Department of Transportation classification of radioactive material. However, there is no historical sampling data for wells located within the LLWP. Therefore, samples taken from the sampling locations included in this plan will require a field sample radiation screen (gamma screen) and a laboratory shipping screen prior to off-Site shipping.

Samples will be transported in accordance with the regulations issued by the DOT (49 CFR 171 through 178) and EPA sample handling, packaging, and shipping methods (40 CFR 261). Additional information is found in MCP-1193.



## **7. DOCUMENTATION**

The FTL or designee is responsible for controlling and maintaining all field documents and records and ensuring that all required documents are submitted to the SAM record coordinator.

Field changes will be implemented by the FTL in accordance with MCP-135, “Creating, Modifying and Canceling Procedures and other DMCS-Controlled Documents.” All entries will be made in permanent, nonsmearable black ink. All errors will be corrected by drawing a single line through the error and entering the correct information. All corrections will be initialed and dated.

The serial number or identification number and disposition of all controlled documents (e.g., chain-of-custody forms) will be recorded in the SAM record coordinator’s document control logbook. If any documents are lost, a new document will be completed. The loss of a document and an explanation of how the loss was rectified will be recorded in the document control logbook. The serial number and disposition of all damaged or destroyed field documents will also be recorded. All voided and completed documents will be maintained in a project file until project completion, at which time all logbooks, unused tags and labels, chain-of-custody copies, etc., will be submitted to the SAM record coordinator.

The following is a list of all controlled documents:

- Chain-of-custody forms
- Sample logbook
- QAPjP
- FSP and attachments
- Health and safety plan.

### **7.1 Labels**

All samples are identified by a sample label. Waterproof, gummed labels will be used. The label will contain the sample collection time and date, preservation used, type of analysis, etc. Labels will remain in the custody of the FTL or his designee when not in use. MCP-1192, “Chain-of-Custody and Sample Labeling for ER and D&D&D Projects,” establishes the container labeling procedure for this project.

### **7.2 Chain-of-Custody Forms**

The chain-of-custody record is a form that serves as a written record of sample handling. When a sample changes custody, the person(s) relinquishing and receiving the sample will sign a chain-of-custody form. Each change of possession will be documented; thus, a written record that tracks sample handling will be established. The custody procedure for this project is established by MCP-1192.

### **7.3 Logbooks**

Information pertaining to sampling activities will be entered in the sample logbook. Entries will be dated and signed by the individual making the entry. All logbooks will have a QC check for accuracy and completeness. MCP-1194, “Logbook Practices for ER and D&D&D Projects,” establishes the logbook use and administration procedure for this project.

## 8. REFERENCES

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